# $e^+$ QWT : Unpolarized VS Polarized mode

Sami Habet

IJCLab.

JLab.

November 2022

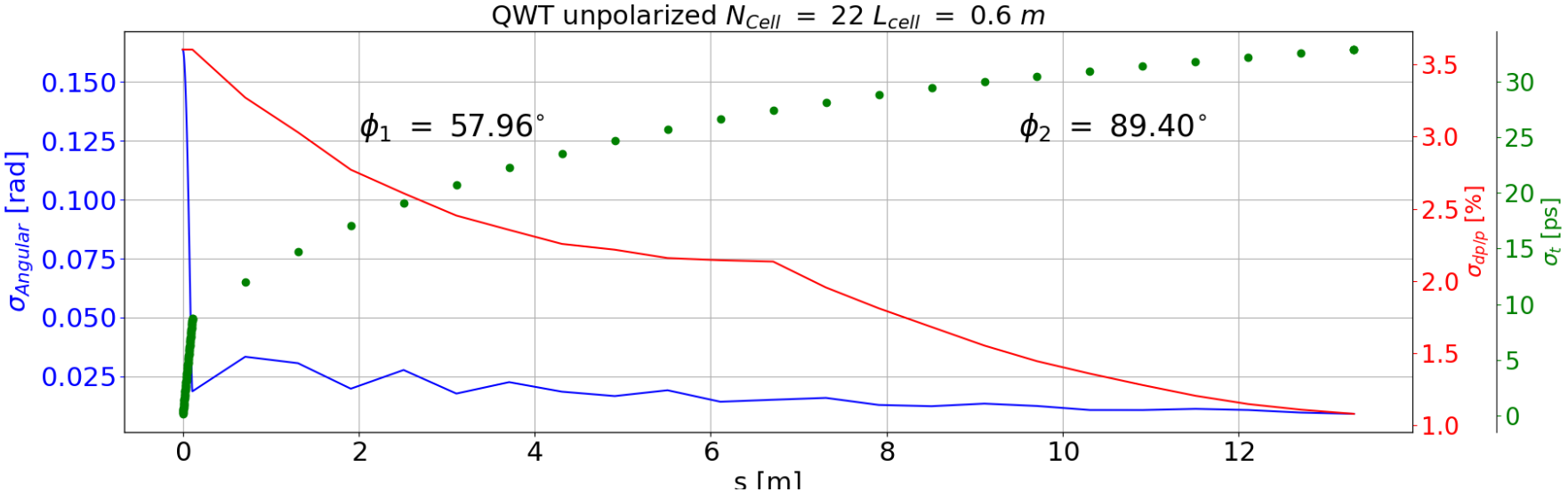
# Plan

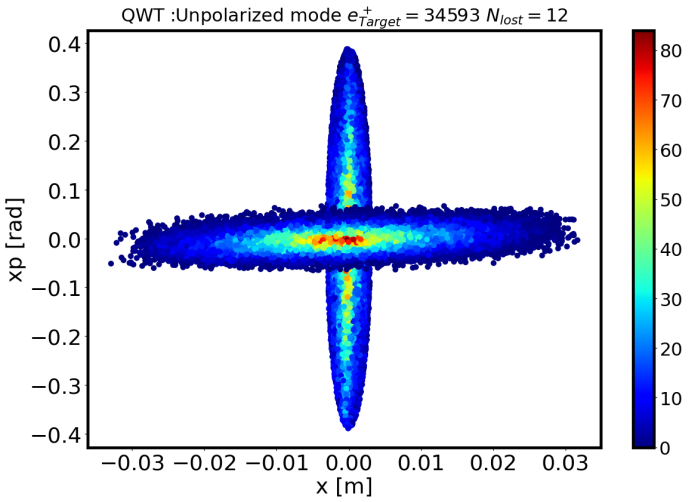
# Previous results

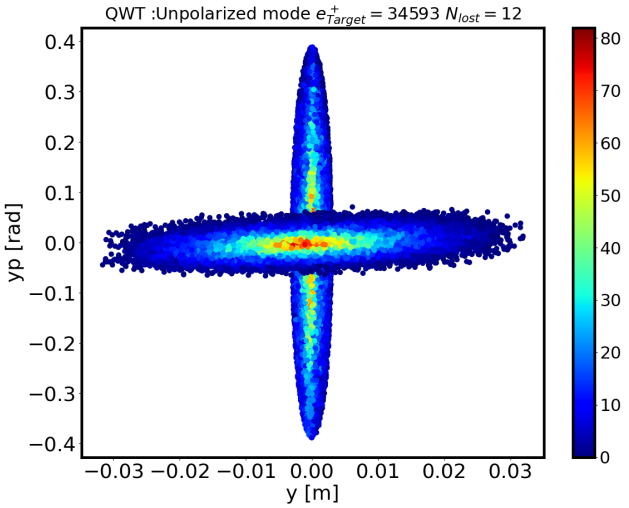
Using optimized field combination in the QWT we were able to :

- Decrease the angular transverse spread.
- Rotate the transverse phase space (x, xp) and (y, yp) at the exit of the QWT.
- **Unpolarized mode**
  - $B_1 = 1.9\ T$
  - $B_2 = 0.2\ T$
  - $L_1 = 0.11\ m$
  - $L_2 = 4.9\ m$
- **Polarized mode**
  - $B_1 = 2.5\ T$
  - $B_2 = 0.5\ T$
  - $L_1 = 0.35\ m$
  - $L_2 = 5.1\ m$
- **Cavities configuration**
  - $f = 1497\ Mhz$
  - $E = 1\ MV/m$
  - $L_{cell} = 0.2\ cm$

# QWT: Transverse phase space rotation Unpolarized mode

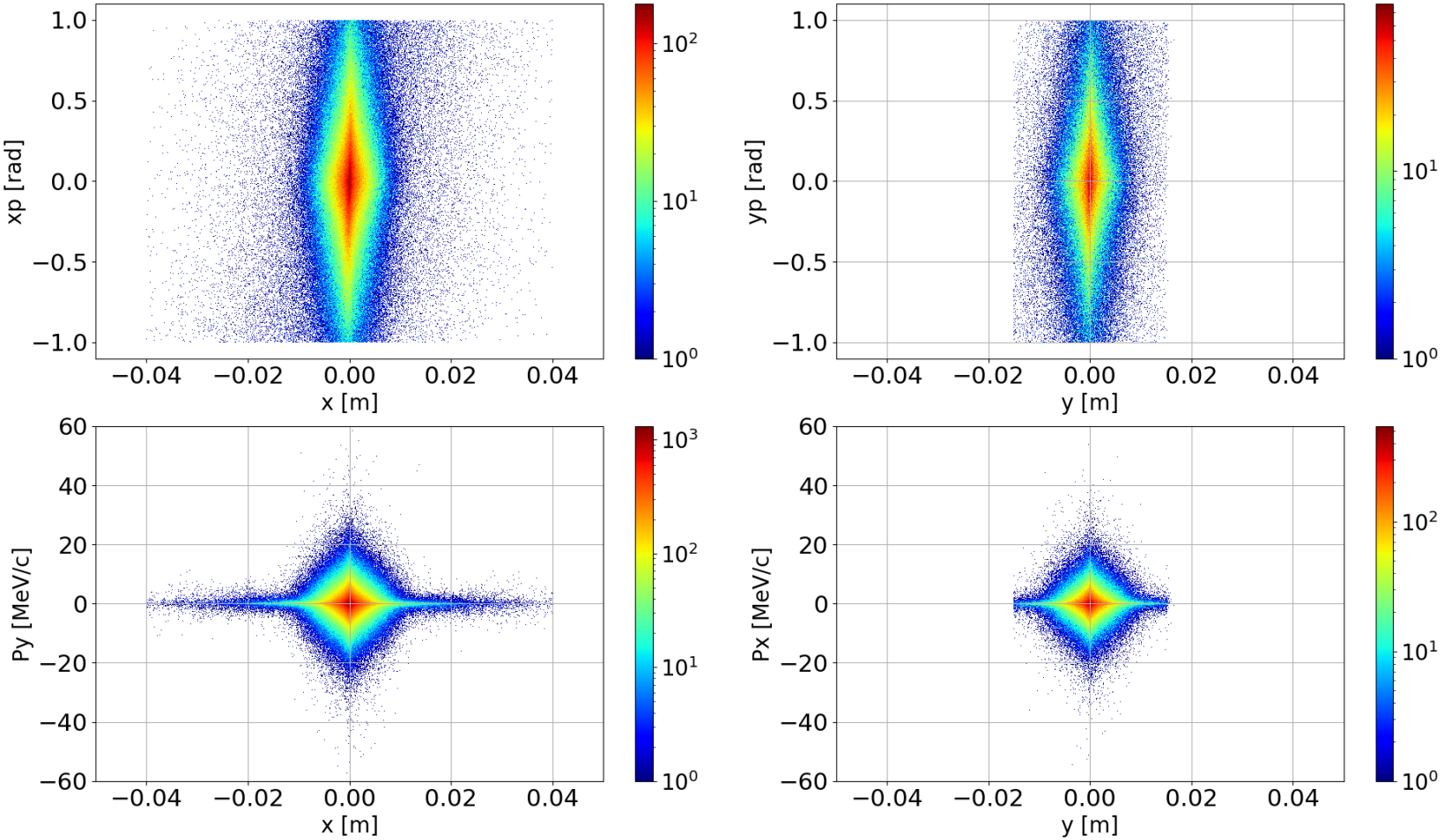


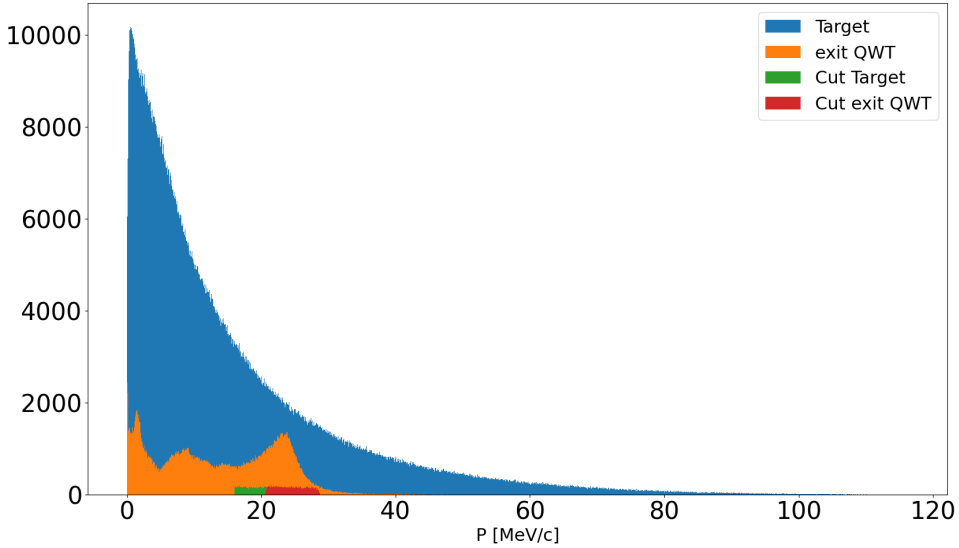
# At the Target exit

- At the exit of the Target, we have:

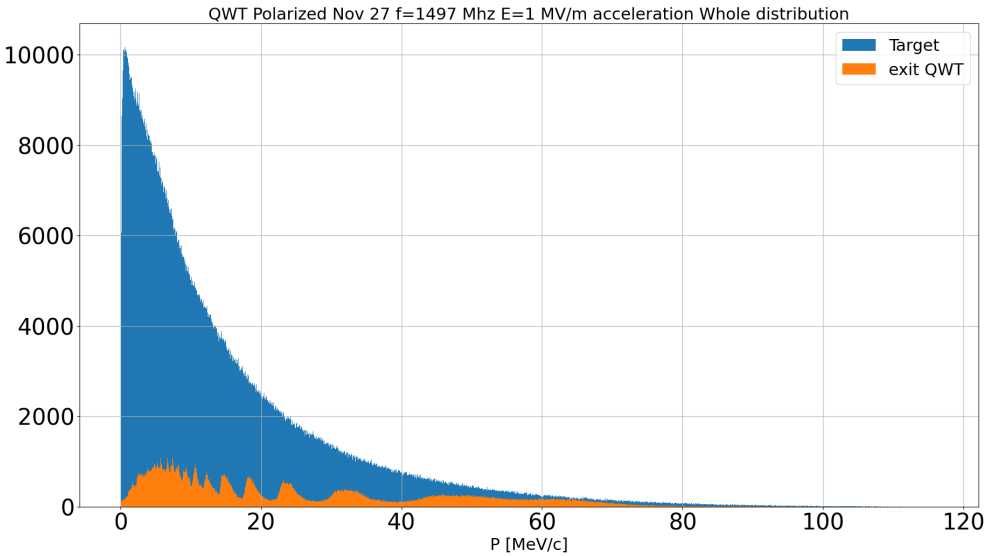


# QWT: Unpolarized Vs Polarized momenta transmission

- As expected, the QWT works as an energy filter
- Because od the harmonics function in the QWT volume acceptance, particles at lower energies goes through the collection system.



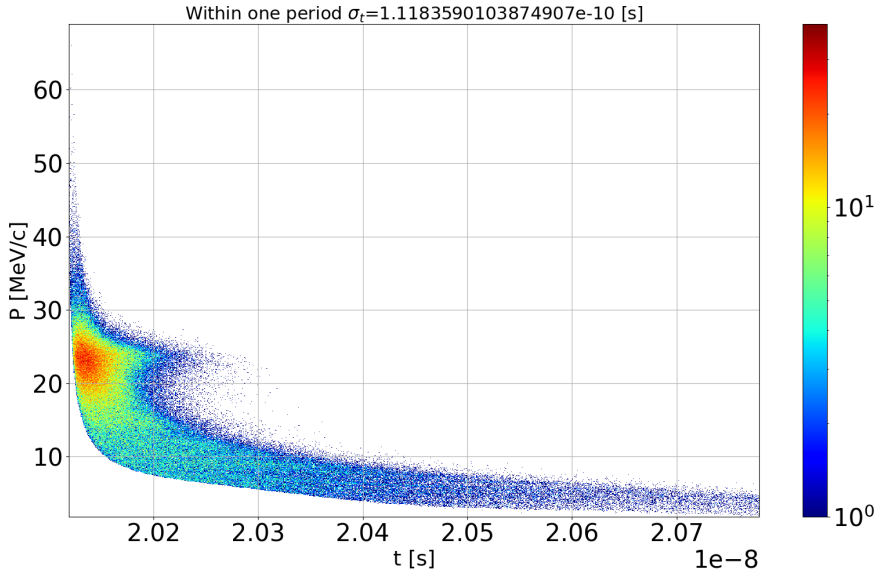

Unpolarized



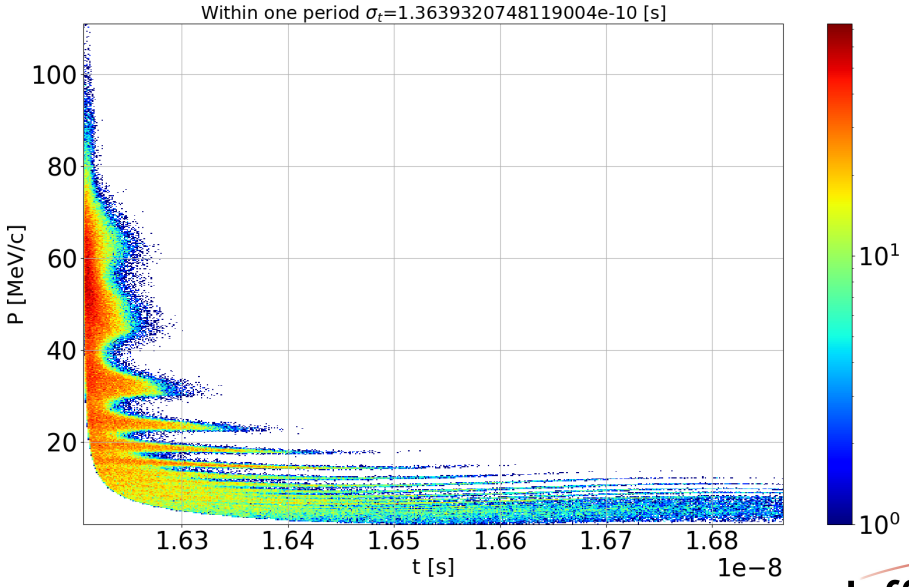

Polarized

# Particles within one period

- High density particle arround the central momentum for the unpolarized and the polarized case
- Huge energy dispersion gotten for the polarized mode

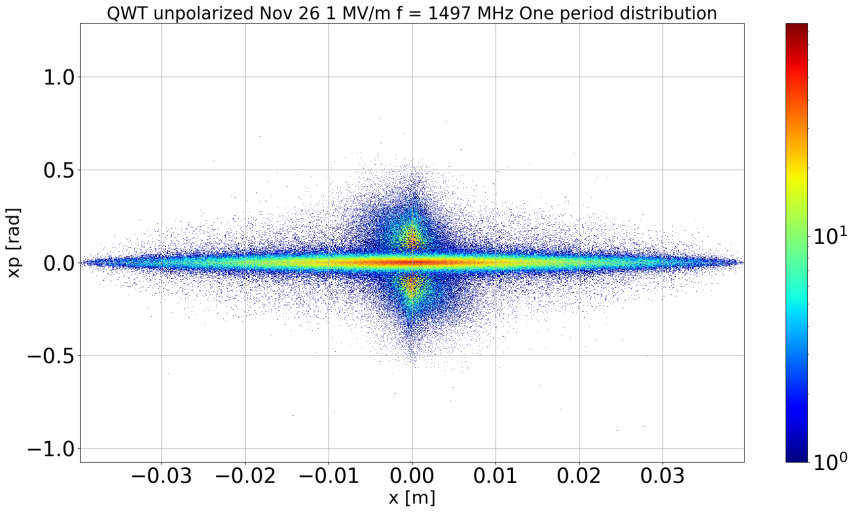


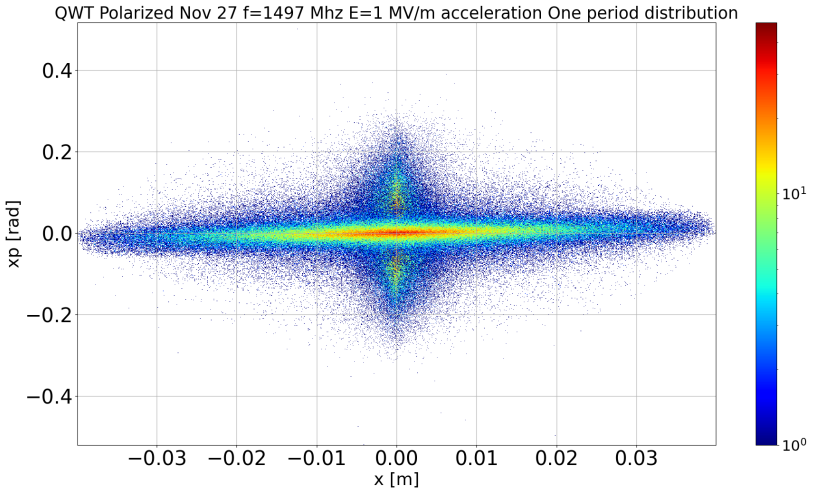

Unpolarized




Polarized

# Unpolarized Vs polarize mode : Transverse rotation

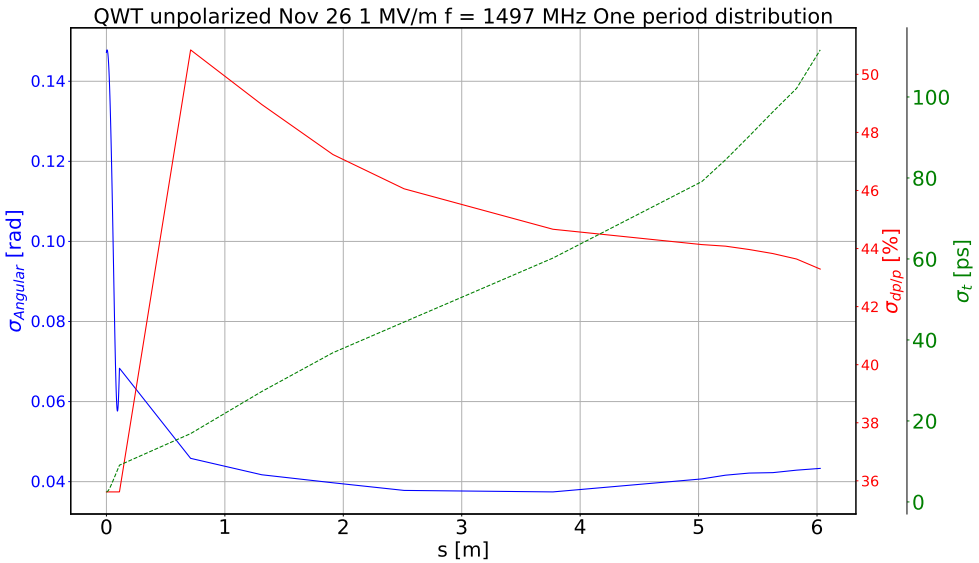


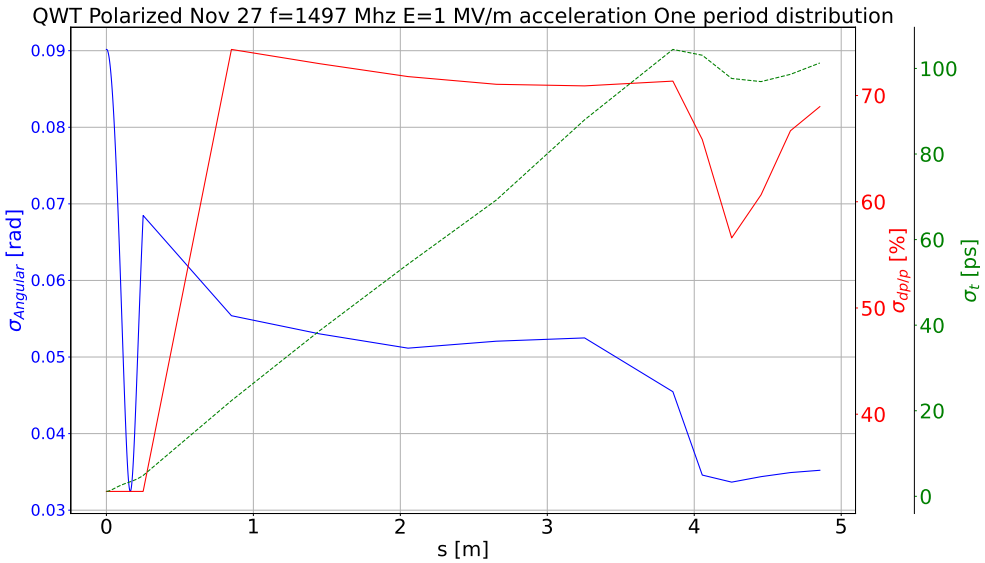

- Transverse phase space rotation for both modes.
- Particles within the QWT acceptance are in the center.

# Unpolarized VS Polarized mode

- Transverse Angular spread decreases for both mode
- Same bunch length at the QWT for Polarized and Unpolarized mode $\sigma_t = 100 \ [ps]$.
- The energy spread $\frac{dp}{p}$ is huge and isn't really affected by the acceleration at this stage, because the cavities were optimized only for a small fraction of particles.



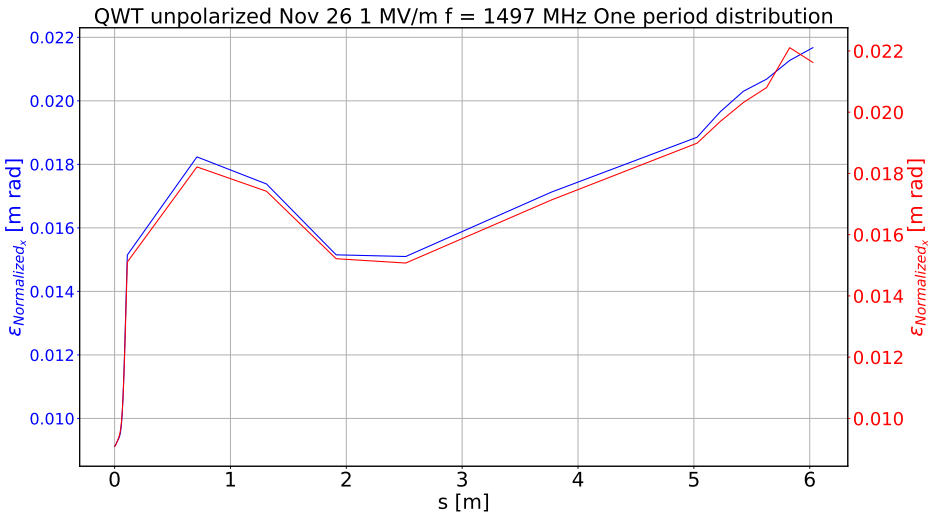

Unpolarized



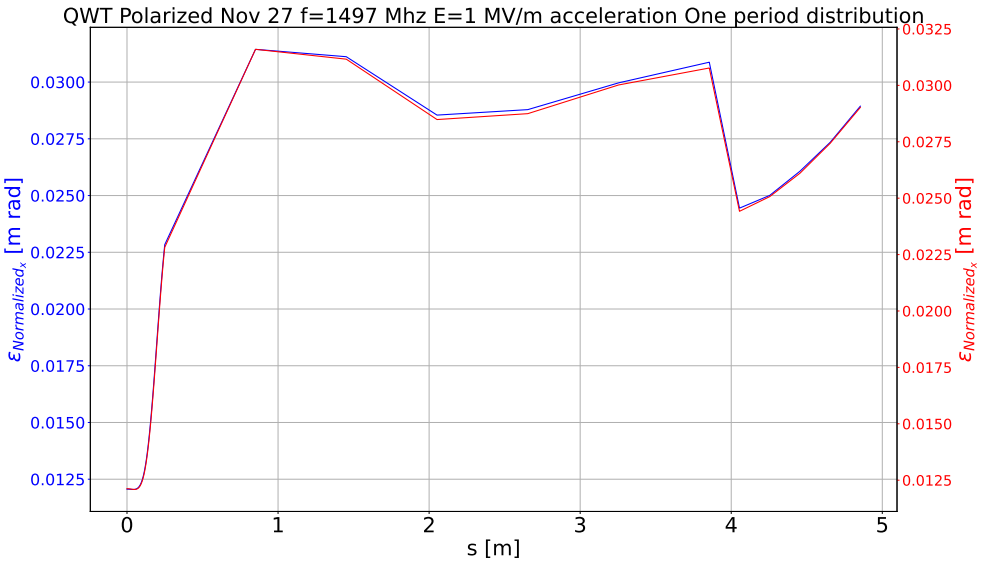

Polarized

# Unpolarized mode : Normalized transverse emittances

- The normalized transverse emittance is raisonable.
- We are still below the ILC limit $\gamma(\epsilon_{Nx} + \epsilon_{Ny}) < 0.07\ [m\ rad]$.



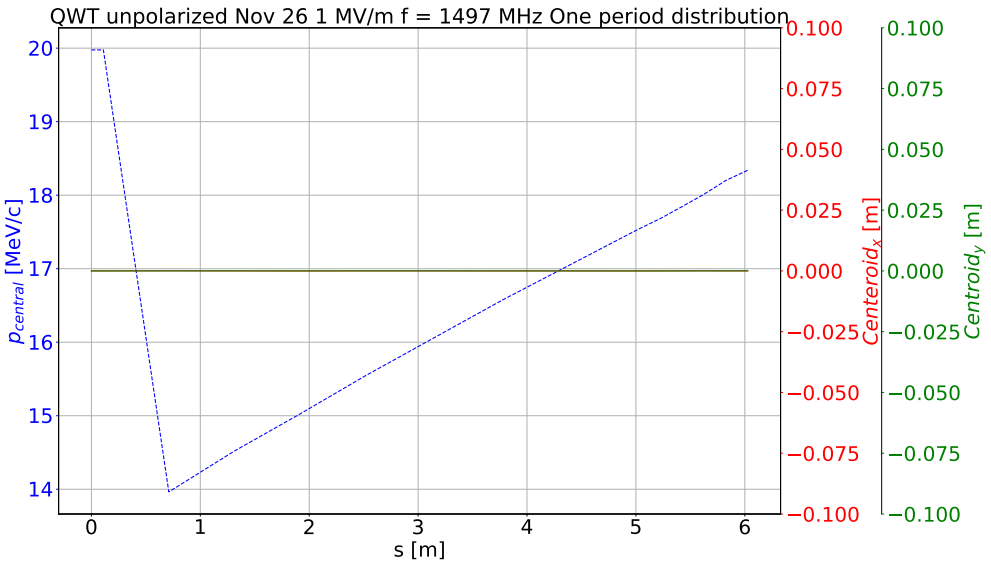

Unpolarized



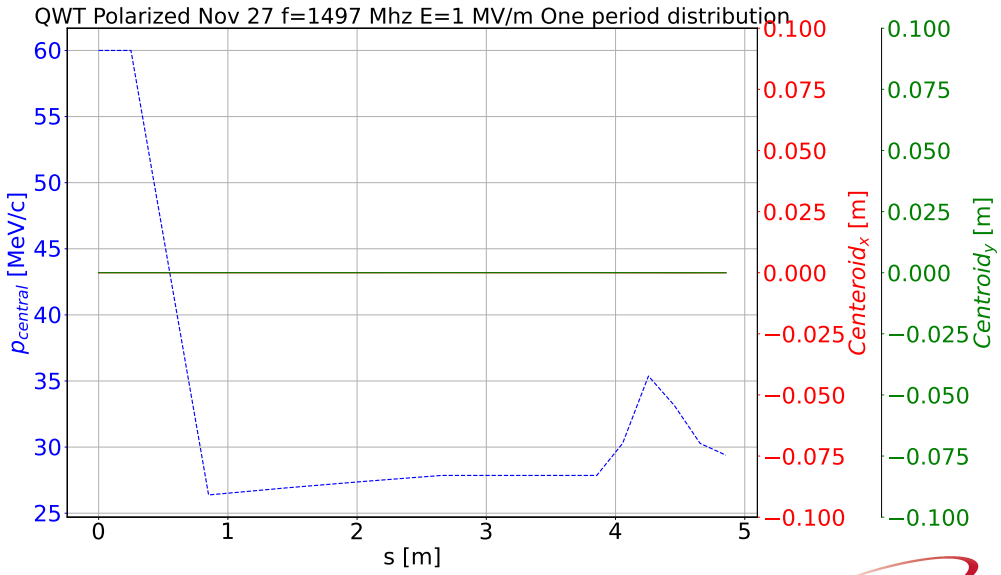

Polarized

# Unpolarized mode : Reference particle trajectory

- The central trajectory over the QWT is straight.
- The central momentum is strange specially for the Polarized cas (still investigating...)



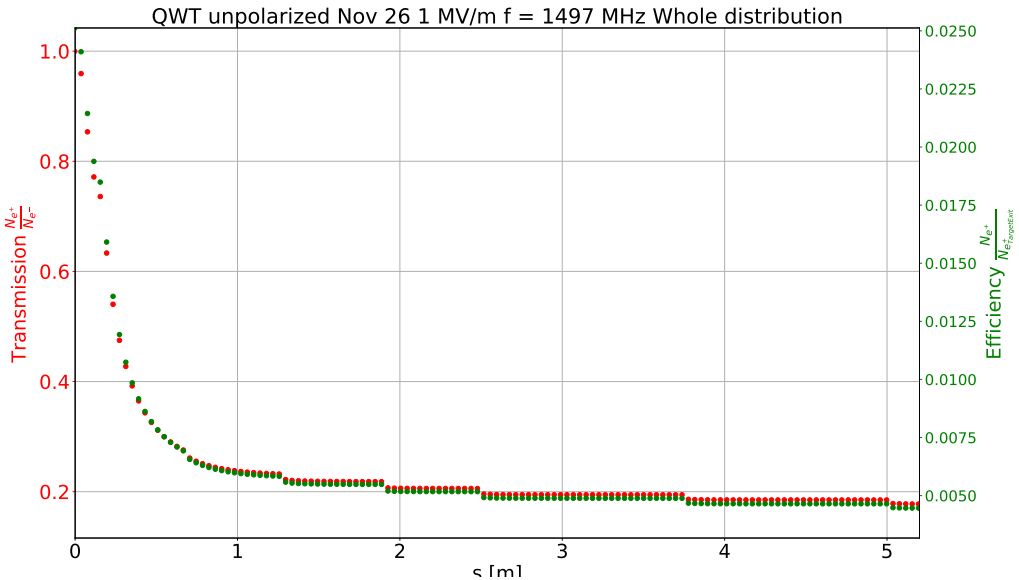

Unpolarized



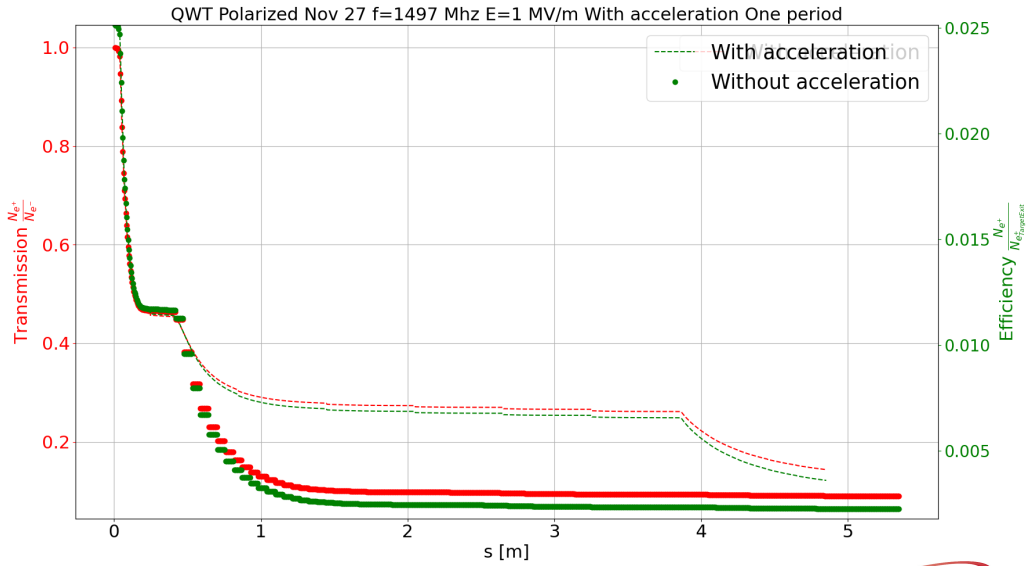

Polarized

# Unpolarized mode : Efficiency and Transmission

- Angular spread decreases for both mode
- Same bunch length at the QWT for Polarized and Unpolarized mode $\sigma_t = 100 \ [ps]$.
- The energy spread $\frac{dp}{p}$ is huge and isn't really affected by the acceleration at this stage




Unpolarized




Polarized

# Plan

# Unpolarized VS Polarized

| Parameters | $QWT_{60MeV}$ | $QWT_{20MeV}$ | $QWT_{60MeV\ OP}$ | $QWT_{20MeV\ OP}$ |
|---|---|---|---|---|
| Radial acceptance $r_0^{max}$ [m] | 0.006 | 0.003 | 0.003 | 0.015 |
| Angular acceptance [rad] | 0.18 | 0.04 | 0.39 | 0.1 |
| $p_{e^+}\ MeV/c$ | [0-120] | [0-120] | [1-80] | [0-30] |
| $1^{st}$ solenoid Length [m] | 0.25 | 0.11 | 0.25 | 0.11 |
| $2^{nd}$ solenoid length [m] | 5 | 5 | 5 | 5 |
| $\frac{N_{e^+_{QWT}}}{N_{e^+_{Target}}}$ Transmission | 0.05 | 0.18 | 0.97 | 0.98 |
| Yield $e^+/e^-$ | $2\ 10^{-3}$ | $5\ 10^{-3}$ | $1\ 10^{-3}$ | $2.4\ 10^{-3}$ |
| Normalized transverse $\epsilon$ [m rad] | | | 0.03 | 0.02 |

# Plan

# Conclusion

- The momentum selection chicane is mondatory.
- We can only collect and transport particle within the QWT acceptance
- We can't make any statement before using the first chicane to select the wanted central momentum, but we already know the accepted particle distribution that we have to transport to the CEBAF.
- The cavities are optimized only for the particles within the collection system acceptance
- We can't optimize the QWT for all energies, but for a given momentum, the system collect effectively the distribution around the $p_0$.